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09/920,891	08/02/2001	Michael Kwan	A4231/T34410	9729

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APPLIED MATERIALS, INC.
2881 SCOTT BLVD. M/S 2061
SANTA CLARA, CA 95050

EXAMINER	
KACKAR, RAM N	

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Paper No. 1003

Application Number: 09/920,891
Filing Date: August 02, 2001
Appellant(s): KWAN ET AL.

Patrick M. Boucher
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 09/15/2003.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is correct.

(7) Grouping of Claims

The rejection of claims 17-22 stand or fall together.

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

5,990,000	***Hong et al***	***11-1999***
6,030,881	***Papasouliotis et al***	***02-2000***
6,268,274	***Wang et al***	***07-2001***
6,310,755	***Kholodenko et al***	***10-2001***
5,316,278	***Sherstinsky et al***	***05-1994***

(10) Grounds of Rejection

The following ground(s) of rejection applicable to the appealed claims are copied from examiners last office action:

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims17-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hong et al (US patent Number 5990000) in view of Papasouliotis et al (US patent Number 6030881).

Hong et al disclose a computer readable storage medium having a computer readable program embodied therein (See Col 6 line 58-65), for controlling the mixture of gases, chamber pressure, temperature, RF power level, pedestal position and other parameters of a process for deposition of a dielectric layer according to a three-step deposition/etch back/deposition process

(See Fig 2A 230-245) so that it covers plurality of raised features and at least partially fills in gaps. (See Col 15 line 30-33).

Hong et al do not disclose that the deposition part of their three-step process could be a simultaneous deposition/Etch process. Consequently they do not disclose a mixture of deposition and inert gas and the ratio of deposition and sputter etch.

Papasouliotis et al disclose a multi step process using a mixture of deposition and an inert gas and teach that the ratio of deposition/etch for the simultaneous deposition and etch in first and third step, should be greater than 1 and preferably between 4 and 50 to ensure net deposition (Abstract and Col 4 line10-16).

There fore it would have been obvious to one having ordinary skill in the art at the time invention was made to modify the simple deposition steps (Step 230 and 245 of Fig 2A) of Hong et al's to simultaneous deposition/sputter steps by using a mixture of deposition and inert gas and maintain the ratio of Deposition/Sputter greater than 1 in order to have net deposition over gaps of high aspect ratios and be able to fill the bottom of the gap better before the closure of the gap at the top.

Regarding Claim 17 (c,d) and 20(g(iii-iv) Hong et al disclose a chemical etch step (Step 235 Fig 2A) after the first deposition step.

Hong et al do not explicitly disclose a substrate-cooling step before starting etchant gases.

Papasouliotis et al disclose changing temperature before transition from deposition to etching (Col 8 lines 42-45).

Since the deposition step is typically done at a higher substrate temperature (See Col 4 line 24, Step 210 Fig 2A and Orczyk - US 5937323 Col 1 line 30-34) and etch process is done at

a lower temperature, it would have been obvious to one having ordinary skill in the art at the time invention was made to bring substrate to a lower temperature after deposition step and before etch step so as to be able to control the substrate temperature properly at a lower value for etch.

(11) Response to Argument

Status of prior art

During the fabrication of microcircuits on a semiconductor substrate, occasionally, there is a need to fill gaps of narrow widths and large depths or gaps with high aspect ratio being equal to the ratio of depth/width. Ordinary deposition tends to deposit more material at the corners. If allowed to continue the material at the corners joins and closes the gap at top surface and leaves a hole underneath (Hong et al Fig 2C and 2D and Papasoliotis et al Fig 2A and 2B). In the prior art therefore, deposition step was followed by an etch (removal) step to selectively remove material to open the hole from the top. This was then followed by another deposition step to finally close the gap. Sometimes the steps needed to be repeated. As aspect ratio have become even higher, above process has been found deficient.

Papasoliotis et al and the applicant have found that a modified deposition step having simultaneous deposition and etch is beneficial in this situation. Ratio of deposition/etch determines net deposition or net removal of material. Papasoliotis et al have disclosed the steps of this process without being too process specific. They have disclosed that transition of a deposition step to an etch step may in general be accompanied by change of process parameters including the temperature.

Response to Argument

Applicant argues that neither Hong nor Papasouliotis teach or suggest a separate cooling step. Applicant further argues that in Papasoliotis the reference to change of temperature at the transition from deposition to etch is not equivalent to a cooling step and in Sherstinsky and Kholodenko the cooling step in reference to etching is for the purpose of maintaining a temperature rather than reducing the temperature.

Papasoliotis et al indicate that in general, a change of temperature may be required after depostion in preparation for the etch. Considering this in view of the fact that, plasma deposition in general is accompanied by an elevation in temperature while etching by efforts to cool the substrate, it would have been obvious that in general a cooling step after deposition may be needed in preparation for etching. It should be understood that "cooling step" sets up the hardware for cooling and the amount of cooling is controlled by the system according to the associated parameters like time and temperature and the heat load generated by the process.

Secondly, as taught by Sherstinsky and Kholodenko etching step may need cooling, at least for maintaining the substrate at a low temperature. As plasma and ion bombardment is the cause of substrate heat during etch, it would be obvious and prudent to make sure that the cooling system is ready before plasma is turned on for etching since, cooling is not instantaneous.

Moreover, transposition of process steps or the splitting of steps has been held obvious (*Ex Parte Rubin* 128 USPQ 440) and so is performance of two steps simultaneously (*In re Tatincloux* 108 USPQ 125 (CCPA 1955)).

Applicant further argues that there is no motivation to combine Hong with Papasoliotis in the manner suggested and because of differences in PECVD and HDP-CVD there is no reasonable expectation of success.

Hong et al teach the use of computer with memory and instructions to execute a Deposition/Etch/Deposition process using PECVD and suggest that induction coupled HDP device could equally benefit from Dep/Etch/Dep process controlled by the computer (Col 5 lines 28-30). Papasoliotis et al on the other hand disclose the advantage of HDP and simultaneous

dep/etch for filling gaps of high aspect ratio. Nothing they say amounts to leading away from the invention.

In view of this, applicant's suggestion that there was even a hint of teaching away and less than reasonable expectation of success is in correct

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

RK
October 14, 2003

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